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ABSTRACT

This study evaluated the effectiveness of the use of videodisc technology in a school system. The videodisc "Understanding Chemistry and Energy" (Systems Impact, 1987) having 20 lessons was used in Physical Science classes (grade 9) and Biology classes (grades 10 and 11) in an experimental school. It was designed to be used with a variety of classes especially classes for studying some aspects of chemistry. Printed worksheets and quizzes were also provided to the experimental classes. Because the differences in pre and posttest scores were very large for the experimental group as compared to the control group, items were analyzed by teachers to determine whether they were covered or not during classroom instruction. For the items covered a lot or some during class, there were significant differences between the two groups. (YP)

An Evaluative Study of a Level One Videodisc Based Chemistry Program

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I. Purpose

As part of a larger study evaluating the effectiveness of the use of videodisc technology in a school system (Hasselbring, et al., 1990), a study was undertaken to compare the chemistry knowledge achievement of students in science classes who used the videodisc "Understanding Chemistry and Energy" (Systems Impact, 1987) and classes that had standard instruction.

II. Subjects and Method

The subjects of the larger study were students in two relatively small K-12 schools in eastern Tennessee. One school was the experimental school in which various videodiscs were used in a variety of different classes while the second school was the control school which used standard instructional techniques. For this sub-study, Physical Science classes (Grade 9) and Biology classes (Grades 10 & 11) from the experimental and control school were used. The videodisc under study was designed to be used with a variety of classes especially classes that are studying some aspects of chemistry but are involved in a total chemistry course, although it could be used in a beginning chemistry course. The videodisc has 20 lessons that are designed to cover a specified set of objectives in a total class presentation format. The teacher manipulates the videodisc to play certain lessons that are described by voice and graphics on the videodisc. Accompanying printed materials (worksheets and quizzes) are provided for use with the students.

III. Results

Results of pretest and posttests were used to compare the students who had used the disc with students from the control school who did not use the disc but had normal classroom instruction. Descriptive statistics for the full 75 point pre- and posttests are given in Table 1. Coefficient alpha reliabilities for the total test based upon all subjects were 0.83 for the pretest and 0.98 for the posttest.

Table 1: Descriptive Statistics on Pretest and Posttest

Pretest

Variable	Value	Label	Mean	Std Dev	Cases
CLASS	2	Control - Bio I	23.9333	3.5750	15
CLASS	3	Control - Phy. Sci.	17.1034	5.2328	29
CLASS	4	Experimental - Phy. Sci	14.5200	3.0973	25
CLASS	5	Experimental - Bio I	14.8636	4.2795	22
CLASS	6	Experimental -Bio I	18.8182	4.9157	11
CLASS	7	Experimental - Phy. Sci	9.3810	4.5329	21
CLASS	8	Control - Bio II	30.6250	5.2355	8

Posttest

Variable	Value	Label	Mean	Std Dev	Cases
CLASS	2	Control - Bio I	26.8667	4.9116	15
CLASS	3	Control - Phy. Sci.	23.3103	6.2399	29
CLASS	4	Experimental - Phy. Sci	67.5600	7.0361	25
CLASS	5	Experimental - Bio I	61.3636	8.2436	22
CLASS	6	Experimental -Bio I	67.7273	5.3496	11
CLASS	7	Experimental - Phy. Sci	63.4762	9.1903	21
CLASS	8	Control - Bio II	34.5000	8.5189	8

Because of the diversity of classes under comparison an overall ANCOVA was not considered to be appropriate although the differences in pre and posttest scores is very large for the experimental group as compared to the control group. The actual analysis undertaken involved two steps. First, the teacher of the subjects at the control school was asked to review the posttest and rate the items on the test as to which of items would have been covered by her instruction in the classes. She rated each item on a three point scale for the various classes which she taught. Items rated "1" were considered by the instructor to have covered "a lot" in her class. Items rated "2" were covered "some" and "3" were covered "not at all". This rating was done for each subject area separately so each area had different ratings for the items.

Items that were rated "1" included questions such as "What charge does each electron have? (Item 2)" and "An atom has 2 electrons in the first set, 8 electrons in the second set, and 5 electrons in the third set. Which set is not complete? (Item 9)". Same items from those rated "2" include; "How many molecules are in this picture" (Item 11) and "How many atoms are in this molecule" (Item 13) [spherical model illustrations provided for both questions].

For the biology classes, 17 items were rated "1" and 44 items were rated "2" with the balance rated "3". For physical science 28 items were rated "1" and 38 rated "2". Due to the fact that both schools had biology classes and physical science classes these became the groups for the ANCOVA analysis.

For the items that were rated "1" for the biology students, the ANCOVA resulted in a statistically significant difference between the groups favoring the experimental treatment. Table 2 shows the unadjusted means, summary of results of the ANCOVA, Perhaps of most interest, is the indication that the experimental students were substantially behind the control students in previous knowledge of the content of the items, as noted by the large difference between pretest means, but that the experimental students surpassed the control group on the posttest.

For the items rated "2" this difference was even more pronounced with the experimental students making large gains in knowledge of these item areas as compared to the control group. Table 3 shows the unadjusted means and sum of results of the ANCOVA.

For the physical science classes a similar pattern was also seen. For the items rated "1", the control group students were slightly ahead of the experimental group on the pretest but were substantially behind on the posttest. Table XV indicates the ANCOVA and related statistics results. For items rated "2", the differences are even more pronounced as noted in Table 5.

Table 2: Means and ANCOVA for Items Rated "1" (Covered "A Lot") - Biology

Pre- and Posttest Means for Items Rated "1" - Biology Classes

Group	Pre- Mean	Pre S.D.	Post- Mean	Post- S.D.	N
Experimental	6.61	2.03	15.91	1.26	33
Control	11.96	2.53	13.52	2.94	23

$F(1,53) = 27.2$ $p < .001$ R square = .35

Table 3: Means and ANCOVA for Items Rated "2" (Covered "Some") - Biology

Pre- and Posttest Means for Items Rated "2" - Biology Classes

Group	Pre- Mean	Pre S.D.	Post- Mean	Post- S.D.	N
Experimental	8.73	2.78	36.88	5.65	33
Control	12.91	3.09	14.43	4.63	23

F (1,53) = 255.8 p < .001 R square = .85

Table 4: Means and ANCOVA for Items Rated "1" (Covered "A Lot") - Physical Sci.

Pre- and Posttest Means for Items Rated "1" - Physical Science Classes

Group	Pre- Mean	Pre S.D.	Post- Mean	Post- S.D.	N
Experimental	6.00	3.16	26.17	2.38	46
Control	9.79	3.98	14.52	4.09	29

F (1,72) = 346.3 p < .001 R square = .83

Table 5: Means and ANCOVA for Items Rated "2" (Covered "Some") - Physical Sci.

Pre- and Posttest Means for Items Rated "2" - Physical Science Classes

Group	Pre- Mean	Pre S.D.	Post- Mean	Post- S.D.	N
Experimental	6.59	2.36	33.13	5.00	46
Control	8.21	2.68	9.52	3.34	29

F (1,72) = 604.6 p < .001 R square = .90

To give a limited assessment of retention of material learned in the video format a delayed posttest on just those students in the experimental group was conducted. The approximate time period between the posttest and the delayed posttest was 12 weeks. Table 6 shows the means and t-tests for

each class. All t-tests were significant at the $p < .01$ level indicating a rather large decrease in mean performance after only this relatively short time period. However, performance was still higher than the control group posttest scores.

Table 6: Means and t-tests for Posttest to Delayed Posttest

	Posttest		Delayed Posttest				
Class	Mean	S.D.	Mean	S.D.	N	t	Sig. t
Phy. Sci - 4	68.04	6.75	49.21	9.54	24	17.1	<.001
Phy. Sci - 7	64.53	6.28	41.00	7.98	19	16.2	<.001
Bio. I - 5	60.75	8.34	49.60	10.92	20	7.82	<.001
Bio. I - 6	67.80	5.63	50.50	5.25	10	8.40	<.001

A replication study was conducted with two physical science classes at the experimental school and one physical science class at the control school during the second year of the overall two year study. Results were consistent with year one with the experimental group having adjusted means statistically higher than the control group ($F(1,56)=94.42$, $p < .001$).

III. Conclusions

As is indicated in the various analyses, students in the experimental group were superior to the control group on the posttest on items that the control group teacher rated as being covered "a lot" and "some" in the normal classroom instruction. Given that most of the items (51 of 75 for biology and 66 of 75 for physical science) related to the normal classroom curriculum it appears that the use of the videodisc could substantially improve student knowledge in these areas by using the disc instead of the normal curricular materials.

References

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